

## **Technical Appendix:**

### **Section 5. Biological Integrity**



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## TA-5. Biological Integrity

### TA-5.1 Biological Stream Monitoring

#### Examples of Tolerance Values and Functional Feeding Groups

**Table TA-5. 1. Examples of tolerance values and functional feeding groups for some fish and benthic macroinvertebrates.**

Fish tolerance values are I=Intolerant, M=Intermediate, T=Tolerant.

**Benthic tolerance values are from 0-10, 10 being most tolerant.**

Fish			Benthic macroinvertebrates		
SPECIES	Tolerance Level	Functional Feeding Group	SPECIES	Tolerance Level	Functional Feeding Group
American eel	M	Generalist	Alloperla sp.	0	Predator
Blacknose dace	T	Omnivore	Ameletus sp.	0	Collector
Blue Ridge sculpin	I	Insectivore	Amphinemura sp.	3	Shredder
Bluegill	T	Invertivore	Asellus sp.	8	Collector
Bluntnose minnow	T	Omnivore	Baetis sp.	6	Collector
Brown bullhead	T	Omnivore	Boyeria sp.	2	Predator
Brown trout	I	Top Predator	Calopteryx sp.	6	Predator
Central stoneroller	M	Algavore	Cheumatopsyche sp.	5	Filterer
Channel catfish	M	Omnivore	Chimarra sp.	4	Filterer
Comely shiner	I	Invertivore	Chironomus sp.	10	Collector
Common carp	T	Omnivore	Cladotanytarsus sp.	7	Filterer
Common shiner	M	Omnivore	Clinocera sp.	6	Predator
Creek chub	T	Generalist	Clioperla sp.	1	Predator
Cutlips minnow	M	Invertivore	Corbicula sp.	6	Filterer
E. silvery minnow	M	Algavore	Crangonyx sp.	4	Collector
Eastern mosquitofish	T	Invertivore	Diploperla sp.	2	Predator
Fallfish	M	Generalist	Drunella sp.	0	Scraper
Fantail darter	M	Insectivore	Eccoptyra sp.	3	Predator
Green sunfish	T	Generalist	Gomphus sp.	5	Predator
Largemouth bass	T	Top Predator	Glyptotendipes sp.	10	Filterer
Longnose dace	M	Omnivore	Haploperla sp.	1	Predator
Margined madtom	M	Invertivore	Hydropsyche sp.	4	Filterer
Northern hogsucker	I	Invertivore	Isonychia sp.	2	Collector
Potomac sculpin	M	Insectivore	Isoperla sp.	2	Predator
Pumpkinseed	T	Invertivore	Ironoquia sp.	4	Shredder
Redbreast sunfish	T	Generalist	Micropsectra sp.	7	Collector
Rosyside dace	M	Invertivore	Neophylax sp.	3	Scraper
Sea lamprey	M	Filter Feeder	Simulium sp.	5	Filterer
Shield darter	I	Insectivore	Spirosperma sp.	10	Collector
Silverjaw minnow	M	Omnivore	Tanytarsini sp.	6	Filterer
Smallmouth bass	M	Top Predator	Taeniopteryx sp.	2	Shredder
White sucker	T	Omnivore	Tropisternus sp.	10	Predator
Yellow bullhead	M	Omnivore	Viviparus sp.	1	Scraper

**Biological Data Available for all Four SPAs****Table TA-5. 2. Biological data available for all four SPAs.**

Key: B=Benthic Macroinvertebrate Data; F=Fish Data; H=Habitat Data; C=Physical Chemistry Data.

<b>CLARKSBURG</b>														
<b>Data Available By Year</b>														
<b>Station</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>
LSCB101					BFHC		BFHC		BHC	BHC	BHC	BHC	BHC	BHC
LSCB102														
LSCB201					BFHC		FHC		BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
LSLS101		BFHC	BHC	BFHC		BFHC	BFHC	BFHC	BHC	BFHC	BFH	BFHC	BFHC	BFHC
LSLS102												BHC	BHC	
LSLS103A		BHC	HC	C										
LSLS103B	FH	BHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
LSLS103C				BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
LSLS104					BFHC	BFHC	BFHC	B	BHC	BFHC	BHC	BFHC	BFHC	BFHC
LSLS109					BHC	HC	FHC	B		BHC	BHC	BFHC	BFHC	BFHC
LSLS110					BHC	BHC	BFHC	B		BHC		BHC	BHC	
LSLS111						BHC	BHC							
LSLS203	BFH	BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC	FHC	BFHC	BFHC	BFHC	BFHC	BFHC
LSLS204	BFH	BFHC	BHC	BFHC	BFHC	BFHC		BFHC	FH	BFHC	BFHC	BFHC	BFHC	
LSLS205	BFH	BFHC	BHC	BFHC	BFHC	BFHC		BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
LSLS206	BFH	BFHC	BHC	HC	BFHC	BHC		B	BHC	BHC	BHC	BHC	BFHC	
LSLS301	BFH	BFHC	BHC	BFHC	FHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	FC
LSLS302	BFH	BFHC	BHC	BFHC		BHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
LSLS303	FH	BFHC	BHC		BHC		BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	F
LSTM106			C	BHC	BHC		BHC	B	BHC	BHC	BHC	BHC	BHC	
LSTM110			BHC	BHC	BHC					BHC	BHC		BHC	BHC
LSTM111										B		BHC		
LSTM112										BC		BHC	BHC	BFHC
LSTM201	BFH	BFHC	BHC	BFHC	BHC	BHC				BHC				BFHC
LSTM202	BFH	BFHC	BHC	BFHC	BHC	BHC				BHC				BFHC
LSTM203		BFH	BH							BH				BFH
LSTM204		BFHC	BHC	BHC						BH				BFHC
LSTM206				BFHC	BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
LSTM302	BFH	BFHC	BHC	BFHC			BFHC			BFHC				BFHC
LSTM303B	BFH	BFHC	BHC	BFHC	BFHC	BHC	BFHC	BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC
LSTM304	BFH	BFHC	BHC	BFHC	FHC		BFHC			FHC		FHC	FHC	

<b>PAINT BRANCH</b>														
<b>Data Available By Year</b>														
<b>Station</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>
PBAT101			BHC	BHC	BHC									
PBFF101				BHC		BHC	BHC							
PBGH108	FHC	BFHC	BFHC	BFHC	BHC	BFHC	BFHC		BHC	BHC	BHC	BFHC	BFHC	BHC
PBGH202				BHC		BHC	BHC							
PBGH208A	FHC	BFHC	BFHC	FHC	BFHC	BFHC	BFHC	FHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
PBGH208B		BFHC	BFHC	BHC	HC					F				
PBGS102A				BHC	B									
PBGS102B				BHC	HC	BHC					BFHC			
PBGS111	BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFH	BFHC	BHC	BFHC	BFHC	BFHC	BFHC
PBGS206	FHC	BFHC	BFHC	FHC	BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
PBLD101					BH	BHC	BHC	B		BHC	BHC			
PBLF202	FHC	BH	BFHC	BFHC		BFHC	BFHC	BFHC	BHC	BFHC	FH	BFHC	BFHC	
PBLF203	FHC	BH	BFHC	BFHC	BHC	BFHC	BFHC	BFHC	BHC	BFHC		BFHC	BFHC	BFHC
PBPB302	FHC	BH	BFHC	BFHC	BFHC	BFHC	BFHC		BHC	BFHC	BFHC	BFHC	BFHC	BFHC
PBPB305C	FHC	BFHC	BFHC	BFHC	BHC	BHC	FHC	BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC
PBRF117	FHC	BH	BFHC	BFHC	BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BHC	BFHC	BFHC	BFHC
PBRF118	FHC	BH	BFHC	HC	BHC	BHC	BHC	B	BHC	BHC	BHC	BHC	BHC	BFHC
PBRF204	FHC	BH	BFHC	BFHC	BFHC	BFHC	BFHC	BFH	BFHC	BFHC	BFHC	BFHC	BFHC	
PBRF206					BFHC	BHC	BFHC	BFHC	BHC	BHC	BFHC	BFHC	BFHC	BFHC



PINEY BRANCH	Data Available By Year														
Station	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	
WBPB101		BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	
WBPB102				BHC	BHC	BHC	BHC	B	BH	BHC	BHC	BHC	BHC	BHC	
WBPB103				BHC	BHC	BHC	BHC	B	BH	BHC	BHC	BHC	BHC	BHC	
WBPB201		BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	FHC	
WBPB202		BFHC	BHC	BFHC	FHC	BFHC	BFHC	BFHC	BFH	BFHC	BHC	BFHC	BFHC	BFHC	
WBPB203A		BFHC	BHC	FHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	
WBPB203B				BFHC	BFHC	BFHC	BFHC	BFHC	BHC	BHC					
WBPB204A		BFHC	BHC	BFHC	FHC	BHC	BFHC	BFH	BHC	BFHC	BFHC	BFHC	BFHC	BFHC	
WBPB204B		B		BHC	BFHC	BFHC	BFHC	BFHC	BHC	BFHC	BFHC	BFHC	BFHC		
WBPB205		BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	
UPPER ROCK CREEK	Data Available By Year														
Station	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	
URNB103											BHC	BHC	BHC	BHC	
URNB105											BHC	BHC	BHC	BHC	
URNB110D											BHC	BHC	BHC	BC	
URNB111											BHC	BHC	BHC	BHC	
URRC104											BHC	BHC	BHC	BHC	
URRC106											BHC	BH	BHC	BHC	

## Summary of Stream Monitoring Protocols

### Benthic Macroinvertebrates

Biological field collection of benthic macroinvertebrates is conducted during the spring index period (March 15 to April 30). Using a D-frame net, a total of twenty samples of the best habitat within a 75 meter stream segment are sampled, each sample confined to a one square foot area. The proportion of available habitat types (e.g., riffles, root wads) within the segment are noted and then used to determine the proportion of samples that are taken within each habitat site. For instance, if within a 75m segment it is noted that approximately 60% of the best available habitat are riffles, 20% root wads, and 20% undercut banks; then twelve samples would be collected within riffles, four at root wads, and four at undercut banks. After twenty samples have been collected, the material is gathered in a sieve bucket and large pieces of debris such as sticks, intact leaves, and stones are rinsed and removed from the sample. The remaining fine material is stored in denatured ethanol to preserve the sample. Back in the lab, the field sample is processed further to get a representative subsample, (must be at least 100 organisms) to identify every individual.

### Fish

Fish are collected in the summer index period (June 1 through the middle of October). Block nets are used at the top and bottom of a 75 meter stream segment to prevent the movement of fish into or out of the sampling segment. The fish survey is conducted using a two pass electrofishing effort (walking upstream) within the 75 meter stream section, following Maryland Biological Stream Survey (MBSS) methods (Kayzak 2001). The fish are stunned momentarily and collected using dip nets and buckets. The fish are then

counted, identified, and released after each electrofishing pass. Anomalies such as ulcerations, lesions, deformities, or parasites are tallied for each species as well.

### Habitat

The objective of the habitat assessment is to describe the structure of the physical features that characterize the condition of the stream resource and influence the existing aquatic community (Barbour and Stribling 1991). A rapid habitat assessment is performed alongside benthic collection in the spring and fish sampling in the summer. Quality and/or extent of certain habitat parameters is assessed, including: 1) instream fish cover, 2) epifaunal substrate, 3) embeddedness, 4) channel alteration, 5) sediment deposition, 6) frequency of riffles, 7) channel flow status, 8) bank vegetative protection, 9) bank stability, and 10) riparian vegetative zone width.

### Physical Chemistry

A multi-parameter probe is placed in the stream's laminar flow to measure water temperature, pH, dissolved oxygen, percent saturation, and conductivity. Air temperature and time of day is also recorded at all stations.

### Benthic and Fish Metrics

**Table TA-5. 3. Metrics used in the fish and benthic macroinvertebrate IBIs.**

<b>Fish IBI</b>	<b>Benthic macroinvertebrate IBI</b>
Total number of species	Taxa richness (Total number of taxa)
Total number of riffle benthic insectivore individuals	Biotic index <sub>2</sub>
Total number of minnow species (Cyprinidae)	Ratio of scrapers (Scrapers divided by (scrapers + filter feeding collectors))
Total number of intolerant species	Proportion of <i>Hydropsyche</i> sp. & <i>Cheumatopsyche</i> sp.
Proportion of tolerant individuals to total individuals	Proportion of dominant taxa
Proportion of individuals as omnivores/generalists	Total number of EPT <sub>3</sub> taxa
Proportion of individuals as pioneering species <sub>1</sub>	Proportion of EPT individuals
Total number of individuals (excluding tolerant sp.)	Proportion of shredders to total individuals
Proportion of individuals with disease/anomalies	

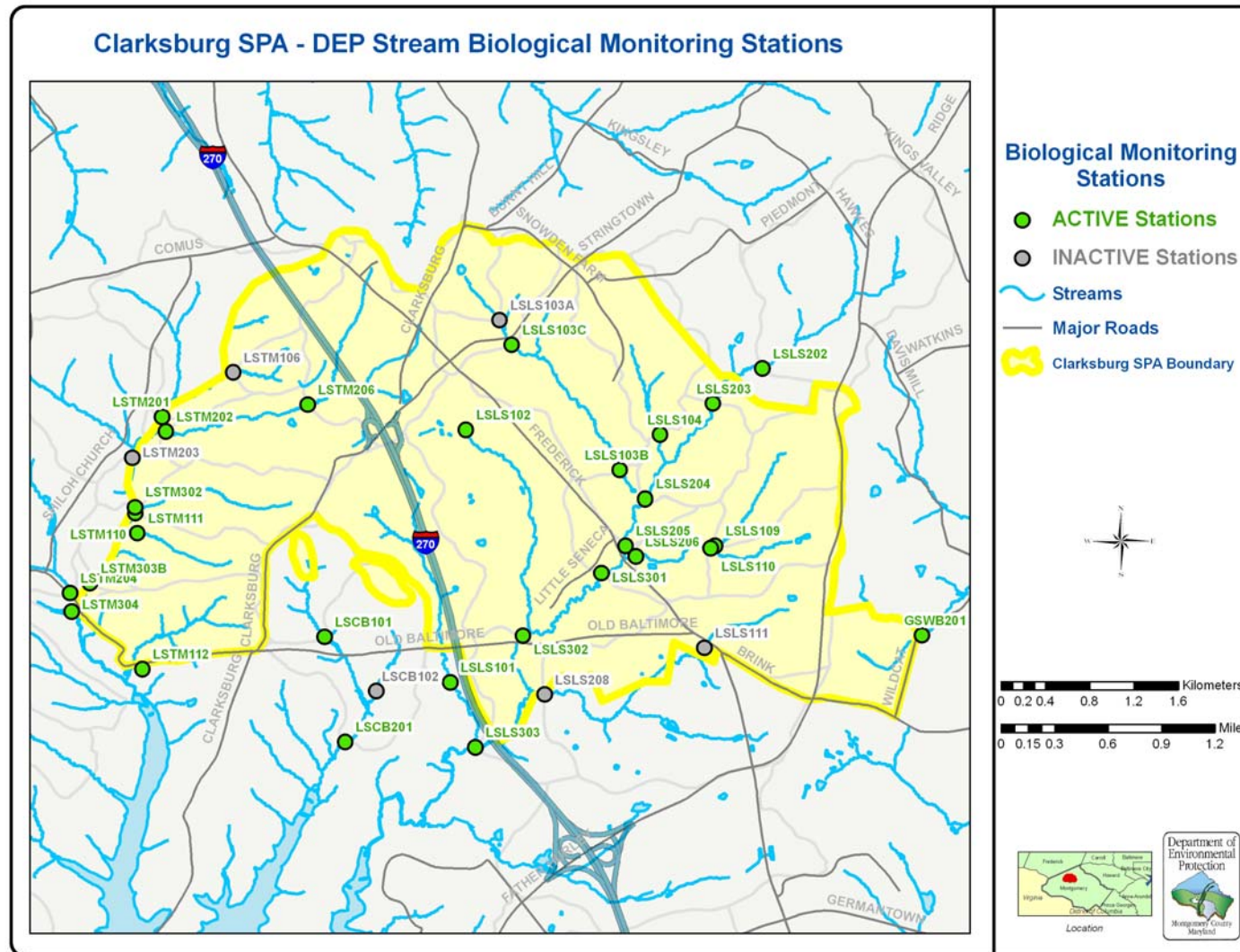
<sub>1</sub> Pioneering species are dominant in fluctuating environments such as streams affected by temporal dessication and/or anthropogenic stresses. Pioneer species include the Blacknose dace, Bluntnose minnow, Creek chub, Green sunfish, and Tesselated darter.

<sub>2</sub> Biotic index is [(number of individuals per taxa \* Tolerance Values for all taxa and total) / total # of organisms]

<sub>3</sub> EPT are taxa that are either mayflies (Ephemoptera), stoneflies (Plecoptera), or caddisflies (Trichoptera); aquatic insects that spend all of their juvenile or larval life stages instream.

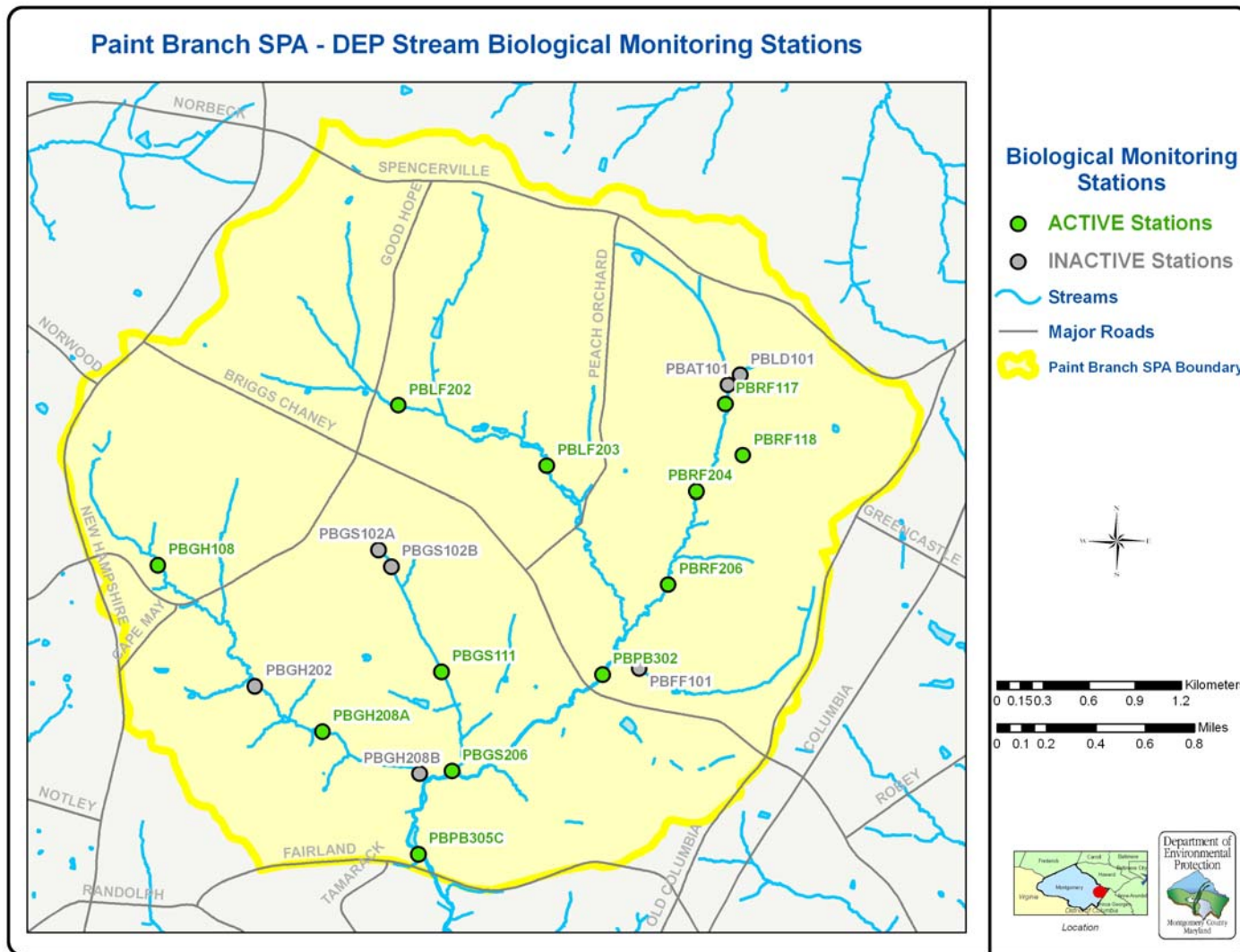
## Maps of SPA Biological Monitoring Stations

### Clarksburg SPA



**Figure TA-5. 1.** Map showing location of biological monitoring stations in the Clarksburg SPA. Inactive stations (in grey) are no longer being monitored due to adjustments in program design, budget, and/or resource availability. Monitoring data is available for years prior to becoming inactive.

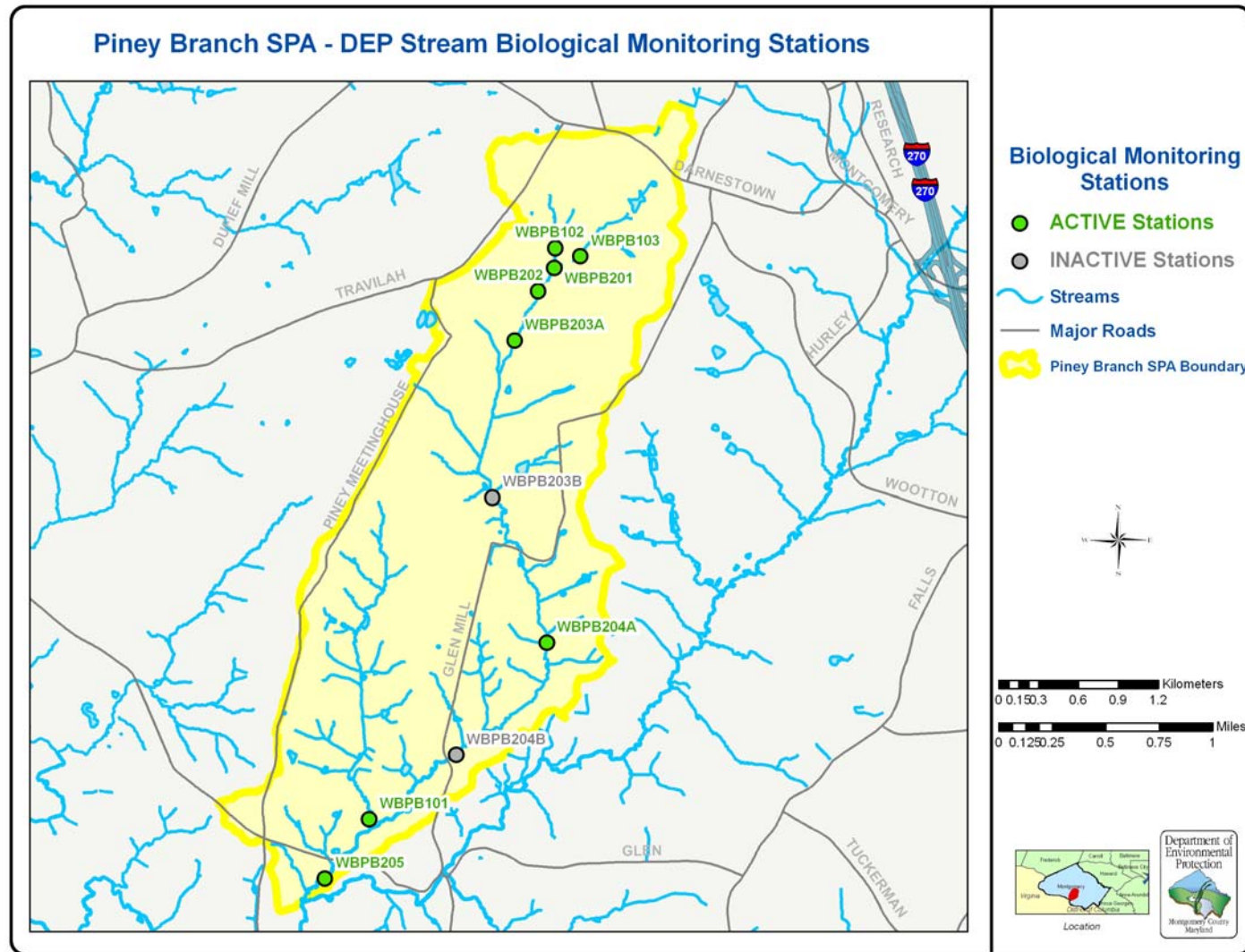
## Paint Branch SPA



**Figure TA-5. 2.** Map showing location of biological monitoring stations in the Paint Branch SPA. Inactive stations (in grey) are no longer being monitored due to adjustments in program design, budget, and/or resource availability. Monitoring data is available for years prior to becoming inactive.

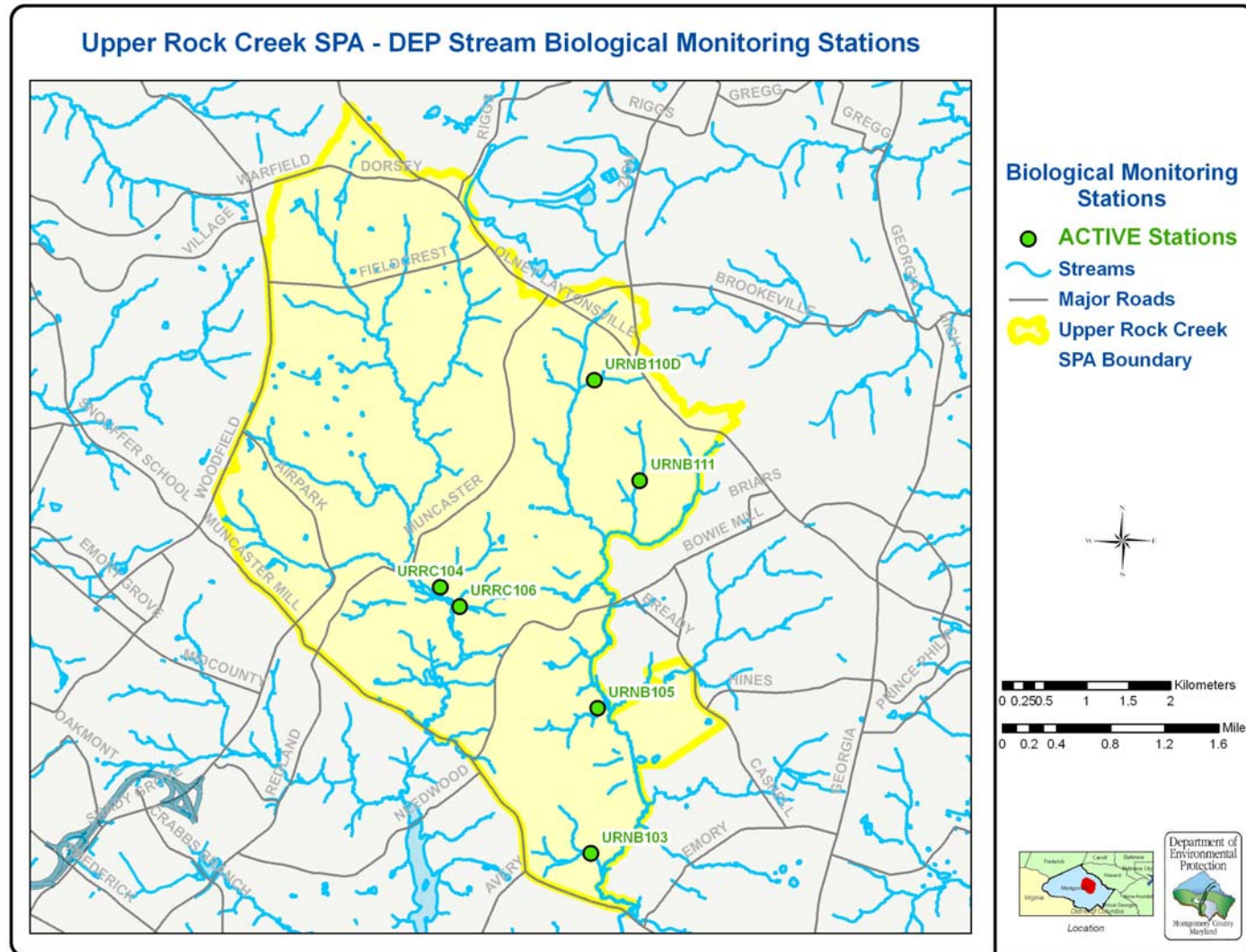


## Piney Branch SPA



**Figure TA-5. 3.** Map showing location of biological monitoring stations in the Piney Branch SPA. Inactive stations (in grey) are no longer being monitored due to adjustments in program design, budget, and/or resource availability. Monitoring data is available for years prior to becoming inactive.

## Upper Rock Creek SPA



**Figure TA-5. 4.** Map showing location of biological monitoring stations in the Upper Rock Creek SPA. Inactive stations (in grey) are no longer being monitored due to adjustments in program design, budget, and/or resource availability. Monitoring data is available for years prior to becoming inactive.

## TA-5.2 Stream Condition Comparison

No appendix materials

## TA-5.3 Benthic Macroinvertebrate IBI Score Comparison

### Fish IBI Score Comparison

Although fish alone may not be the best indicators in headwater streams, fish IBI scores are examined for differences over time within and outside of actively developing areas.

#### Clarksburg

The fish communities in Clarksburg do not show any diversion between the stations within and outside of development activity (Fig. TA-5.5). In fact, there are a few control stations (which are predominantly Ten Mile Creek stations) that have lower fish scores than the impacted stations. A possible explanation for this is the barrier to fish recolonization of the Ten Mile Creek watershed at the Little Seneca Lake. After strong storms, it is very difficult for fish (other than pioneering species) to reestablish themselves in the Ten Mile Creek.

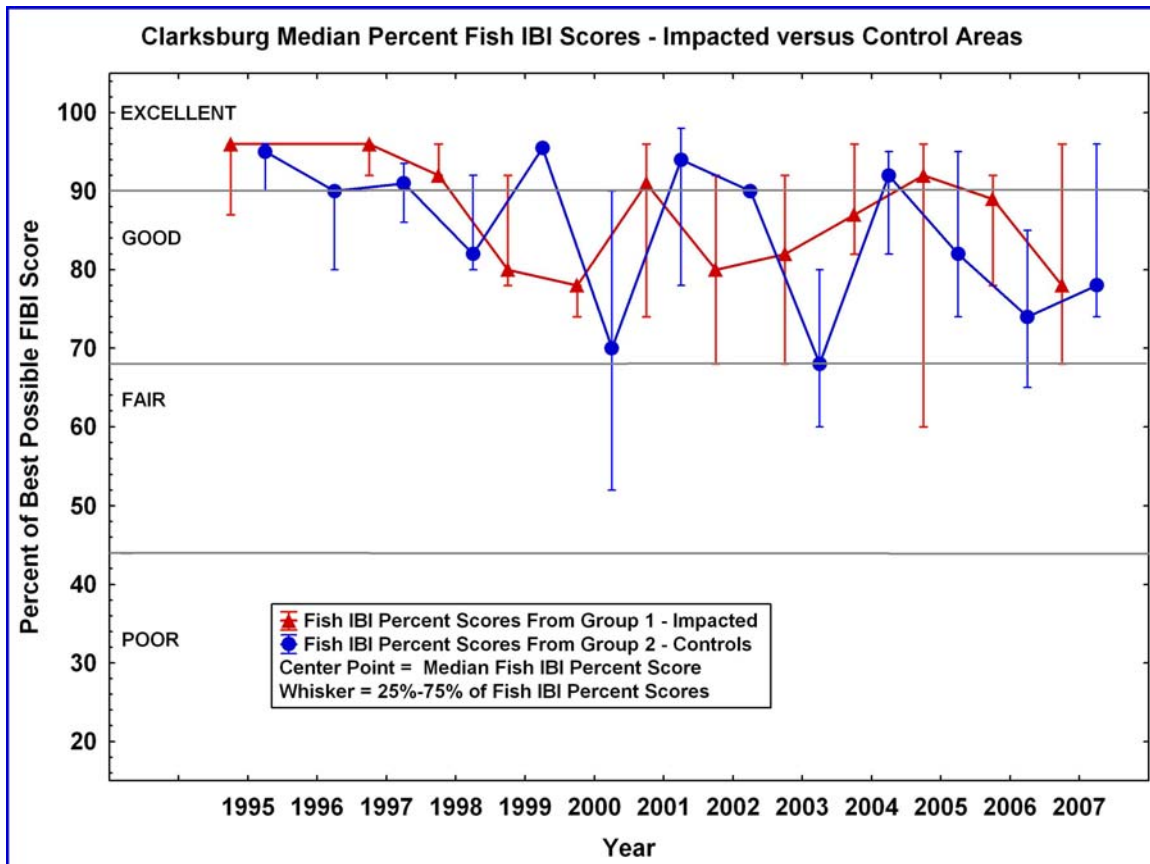


Figure TA-5. 5. Median fish IBI scores for Clarksburg control and test areas.



## Piney Branch

It is clear that there is a degree of separation between the fish IBI percent scores in the control station versus that of the impacted stations for the Piney Branch SPA (Fig. TA-5.6). Note, however, the small sample size for the control. During 2002, the IBI score dropped from *good* to *fair* at the control station during the drought. The improvement seen in both the control and test areas in 2005 is due mostly to the increased number of sculpins found. The Blue Ridge (Fig. TA-5.7) and Potomac sculpin are pollution-sensitive species that live on the stream bottom and are particularly susceptible to sedimentation.

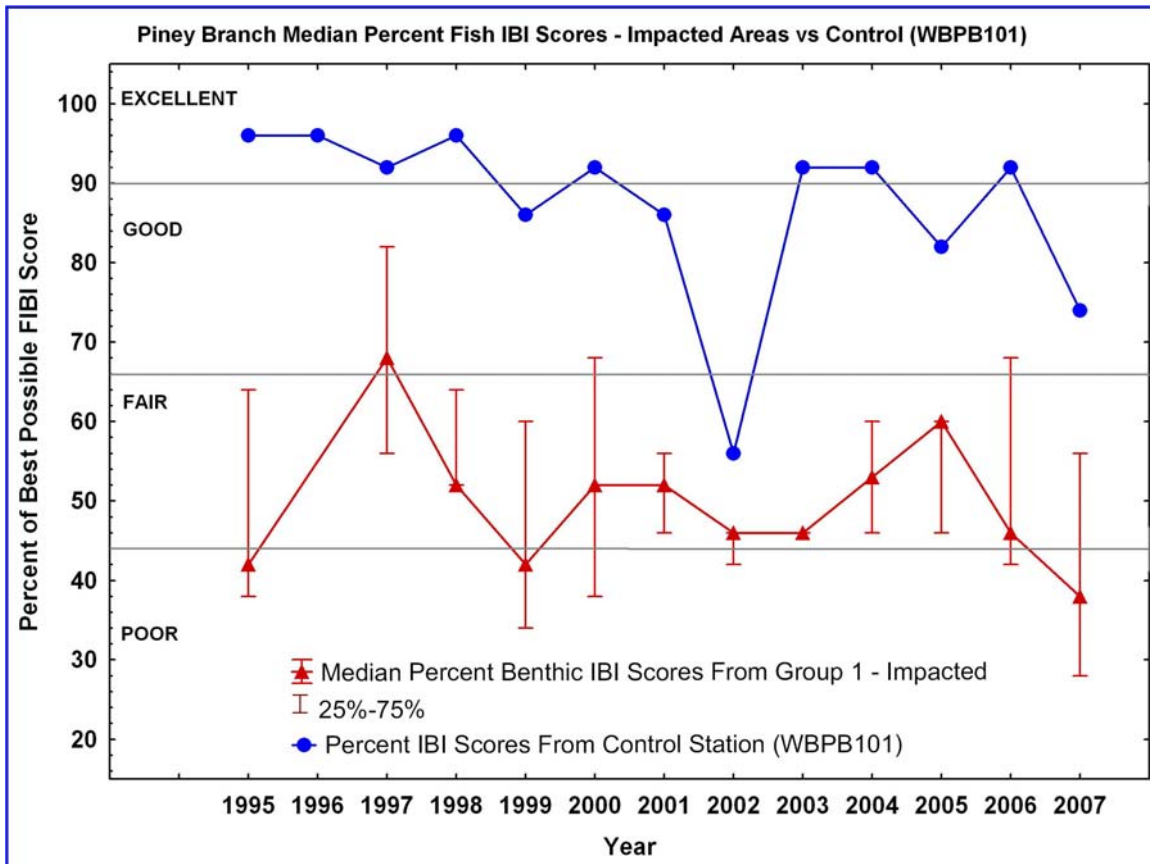


Figure TA-5. 6. Median fish IBI scores for Piney Branch control and test areas.

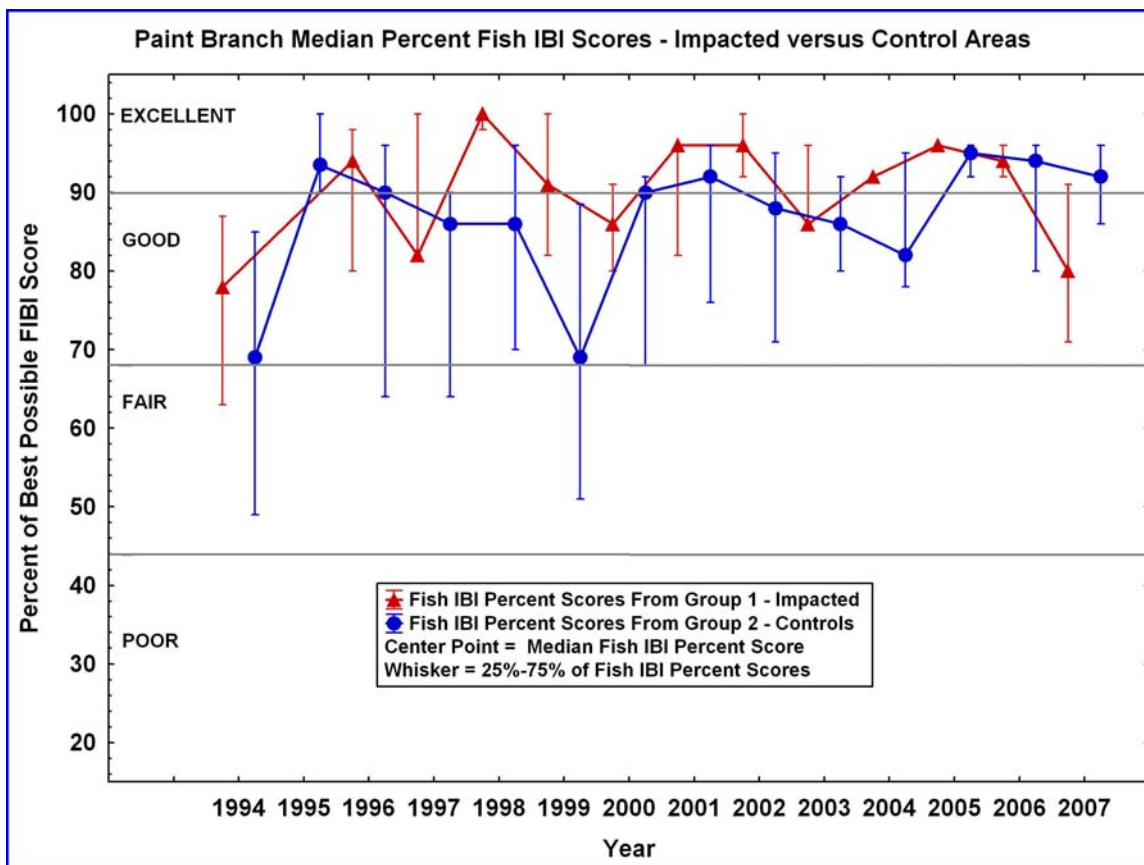


Figure TA-5. 7. Blue Ridge sculpin.



## Paint Branch

In the Paint Branch SPA, over the course of several years, the fish community health in and outside of development areas have managed to stay more or less the same (Fig. TA-5.8).



**Figure TA-5. 8. Median fish IBI scores for Paint Branch SPA control and test areas.**

## Paint Branch Trout

The Paint Branch watershed is designated as a class III naturally reproducing brown trout stream (Fig. TA-5.9). The ability to support trout populations is indicative of excellent water quality, which is rare in such suburban settings. The Good Hope and Gum Springs tributaries are the primary trout spawning and nursery areas (M-NCPPC 1995; MCDEP 1998).

Numerous studies have generally found that the Good Hope tributary is the most dependable spawning and nursery area. Reasons the Good Hope tributary is so suitable for trout spawning are: 1) cool water temperatures (class III streams require temperatures below 68° F), 2) stable and clean gravel & cobble substrate, 3) forested stream buffers, and 4) good baseflow during dry periods. The other Paint Branch tributaries serve as adequate spawning and nursery grounds, but are less reliable.

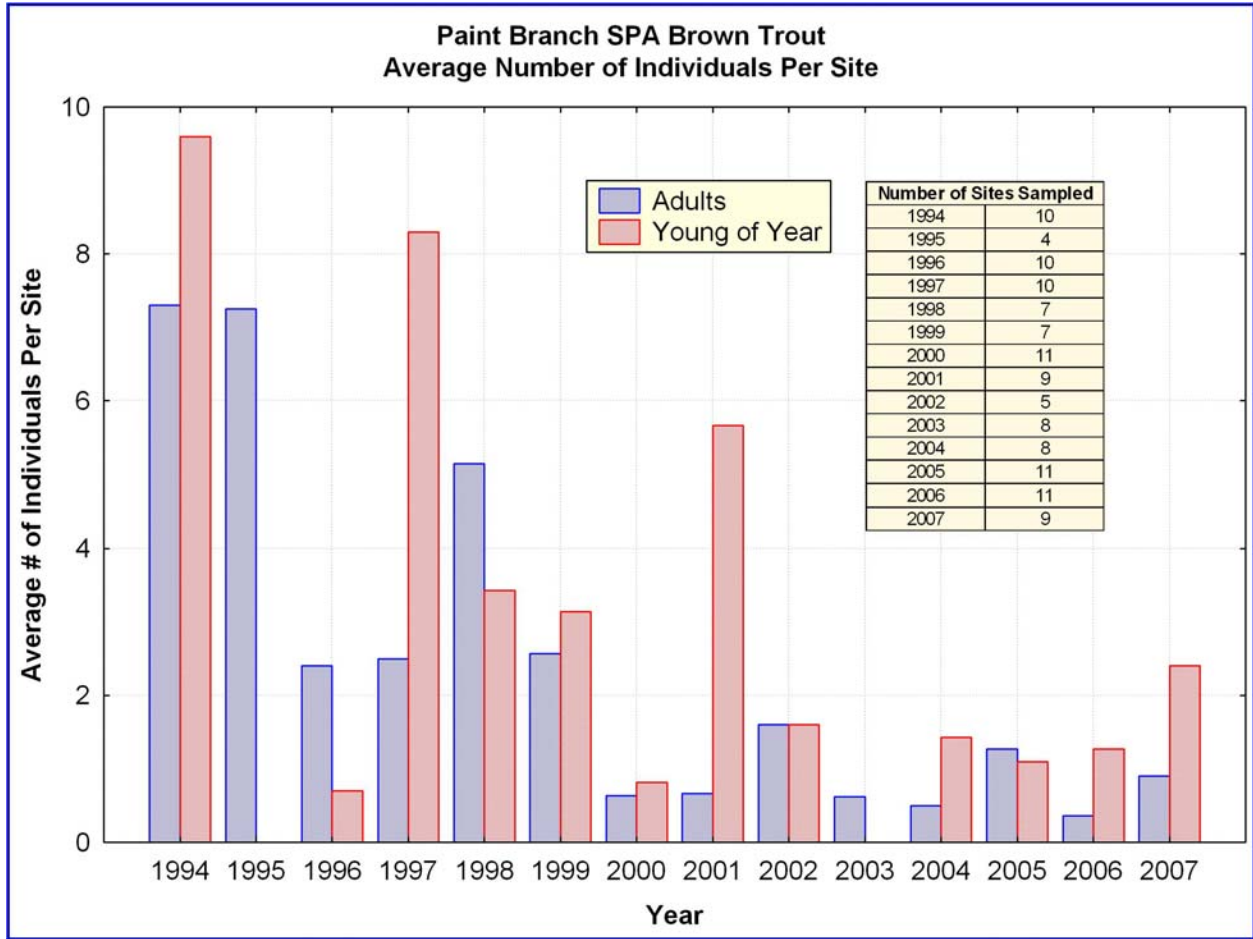
The Gum Springs tributary suffered from several acute impacts in 1994, 1995, and 1996, which degraded stream habitat and water quality for a number of years (MCDEP 1999). In 1999, it was determined that the Oak Springs stormwater management pond was discharging warm water to the Gum Springs tributary, and the thermal impact may have had an effect on cold-water trout spawning in the tributary. The thermal impacts were rectified in 2000 by diverting the water from the pond to the mainstem through an underground pipe (MCDEP 2000).

The Right Fork of the Paint Branch also has been known to support young of year and sometimes adult trout. However, the Columbia Park tributary (feeding station PBRF118) does not provide enough baseflow, especially during dry years, to provide the habitat necessary to sustain a fish community equal to that of the mainstem. The Left Fork of the Paint Branch has a fish blockage below the Maydale Nature Center, with PBLF202 as the associated station.

Figure TA-5.10 shows the number of adult and young of year trout found each year in the Paint Branch SPA, divided by the number of stations monitored that year. For example, not all stations were monitored in 1999 due to a drought. Trout populations were affected by two droughts during the monitoring period—one in 1999 and one in 2002. Trout populations plummeted in 2000 and 2003, immediately following the drought years. The decline in population is likely due to the difficulty spawning in the drought-affected headwater areas. Populations of trout seem to be persisting (mainly in the Good Hope tributary and the mainstem), but have not yet recovered to pre-2000 levels.



**Figure TA-5. 9. Brown Trout.**



**Figure TA-5. 10. Average number of brown trout adult and young of year individuals per station monitored per year found in Paint Branch SPA streams.**

## **TA-5.4 Changes in Benthic Macroinvertebrate Community Structure and Function**

### **Examples of Community Structure and Function**

Shredders are organisms that feed primarily on leaves from plant materials that wash into a stream (and the fungi and bacteria that colonize them) and not on living aquatic vegetation. Plant materials are present as either aquatic vegetation growing in the stream or as dead material (detritus) that has fallen and washed into the stream. Shredders cling to the stream substrate and crawl about looking for detritus or burrow within the clumps of the detritus to live and feed. Shredders are considered specialized feeders and sensitive organisms, and are thought to be well-represented in healthy streams (US EPA 2008).

Organisms identified as collectors, on the other hand, are generalists with a broader range of acceptable food materials, making them more tolerant to pollution that might alter availability of certain food. Collectors also tend to either filter feed or obtain food from loose surface filter films and sediment, and do not require the complex habitat on which shredders rely (US EPA 2008).

Members of the family Chironimidae (midges) fit a wide variety of functional feeding groups and habits, but are generally tolerant to pollution and environmental stressors. In addition to their tolerance for environmental disturbance, many have a preference for habitats where food particles size and accumulation are low, and have been identified as having a rapid habitat invasion potential (Pedersen and Perkins 1986; Jones & Clark 1987).

### **Changes in Community Structure and Function**

The benthic macroinvertebrate community composition of the Clarksburg test stations (primarily Town Center and Newcut Road neighborhood stream stations) changed drastically during the development process (2003 to 2007) (Fig. TA-5.11). Shredders declined from 47% to 11% of the community and the more general feeding group called collectors increased from a third (32%) to over half of the community (53%). An overall shift in community structure and function was not evident in the control sites in the Clarksburg SPA (including Ten Mile Creek) where development was not occurring (Fig. TA-5.12).

In addition to an overall reduction in shredders as a group, there is a change in the dominant taxa in the Clarksburg Town Center New Cut Road test sites. The dominant taxa changed from the pollution intolerant and highly sensitive stonefly, *Amphinemura* sp., to the more pollution-tolerant and less sensitive Chironimidae family.

A similar observation was made for the Piney Branch SPA test areas. For data through the construction period, there was a loss of shredders and a shift to collectors becoming the most prevalent functional feeding group in the test areas. For the control, there was an increase in collectors and scrapers as the percentage of filterers was reduced from 41% to

18%. In the test areas, the dominant taxa were Chironimidae (non-biting midges) and *Cheumatopsyche* sp., a type of net-spinning caddisfly. Although caddisflies as a family are considered among the most sensitive stream organisms, net-spinning caddisflies are generalist feeders that remain fairly sedentary, spinning nets to capture fine suspended particles of food. Like Chironimidae, *Cheumatopsyche* sp. are considered very tolerant to disturbance and environmental stressors.

In the control area, there was a shift in dominant taxa from tolerant organisms, prior to 1997, to the prevalence of the intolerant stonefly *Amphinemura* sp. from 1997 to 2007.

The observations for the Paint Branch SPA benthic communities differ from the other two SPAs. Collectors were consistently the predominant feeding group in both the test and control areas. For the test group, collectors make up roughly half of the community before and through construction (Fig. TA-5.13). The same is true of the control groups (Fig. TA-5.14). One notable difference between the test and control groups is that while the percentage of collectors remains fairly consistent, the other functional feeding groups do not. The percentage of shredders in the test areas of the Paint Branch is reduced by over half, from 13% pre-construction to 5% through construction. Filterers are also reduced from 27% to 18%, and increases in the percentages of predators and scrapers are observed. In contrast, these shifts are not as dramatic in the control areas and the ratio of functional feeding groups remains fairly consistent over time. The dominant taxa is Chironimidae during the pre-construction and during construction periods for both the test and control stations.

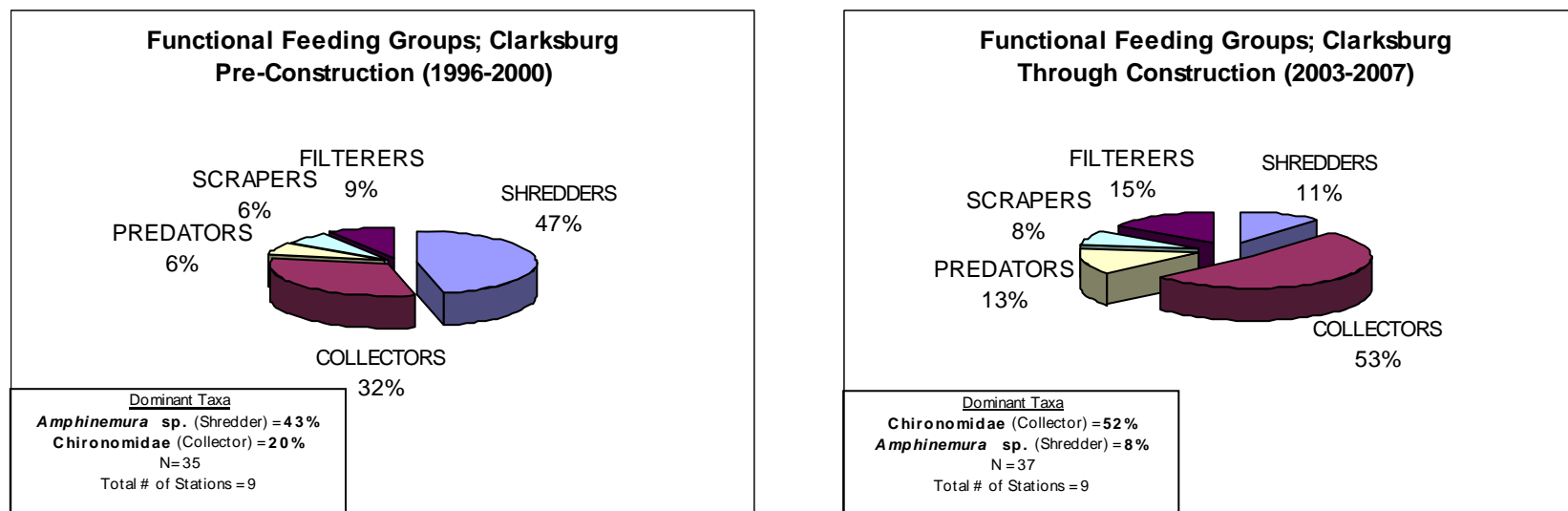


Figure TA-5. 11. Functional feeding groups and dominant taxa in the test areas of the Clarksburg SPA.

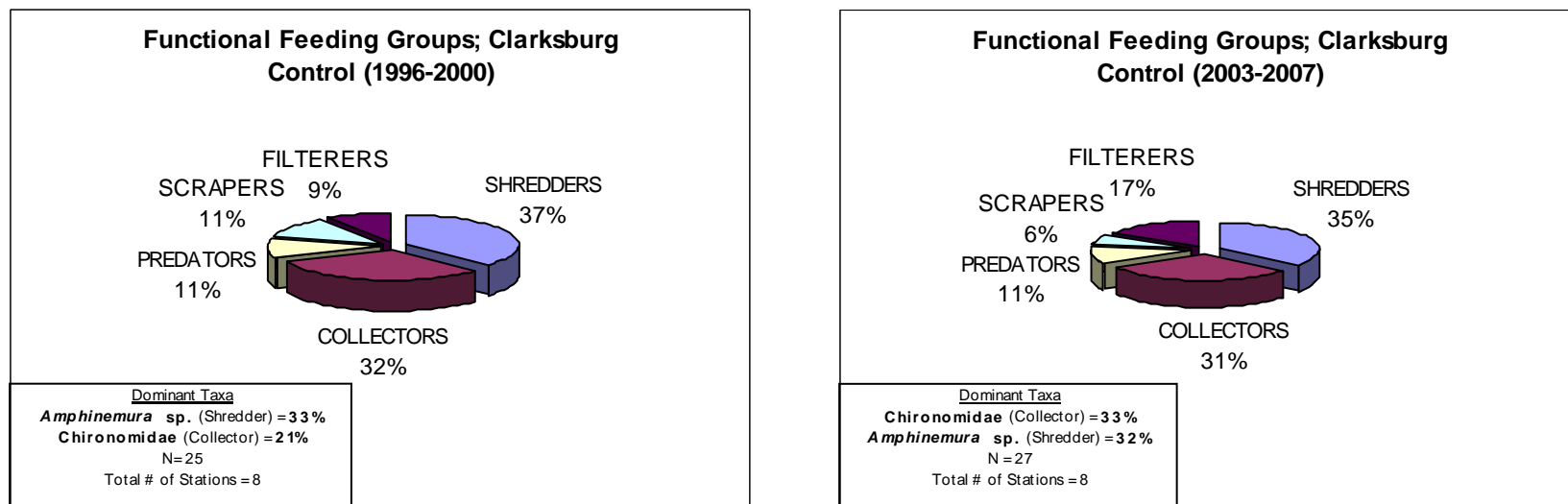
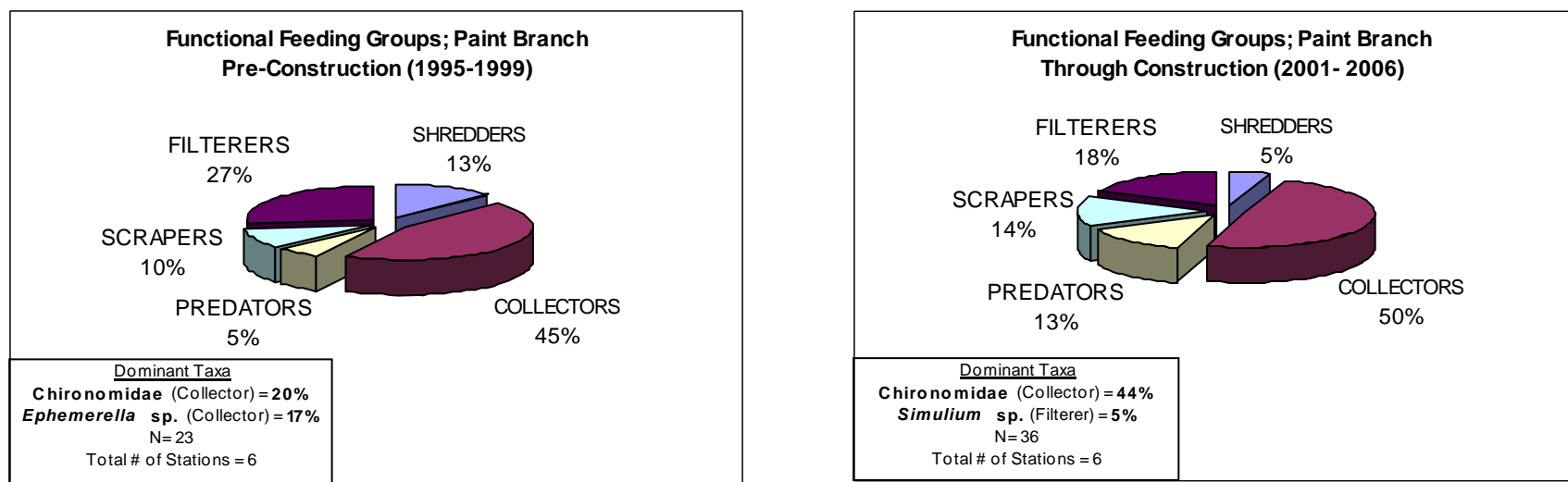
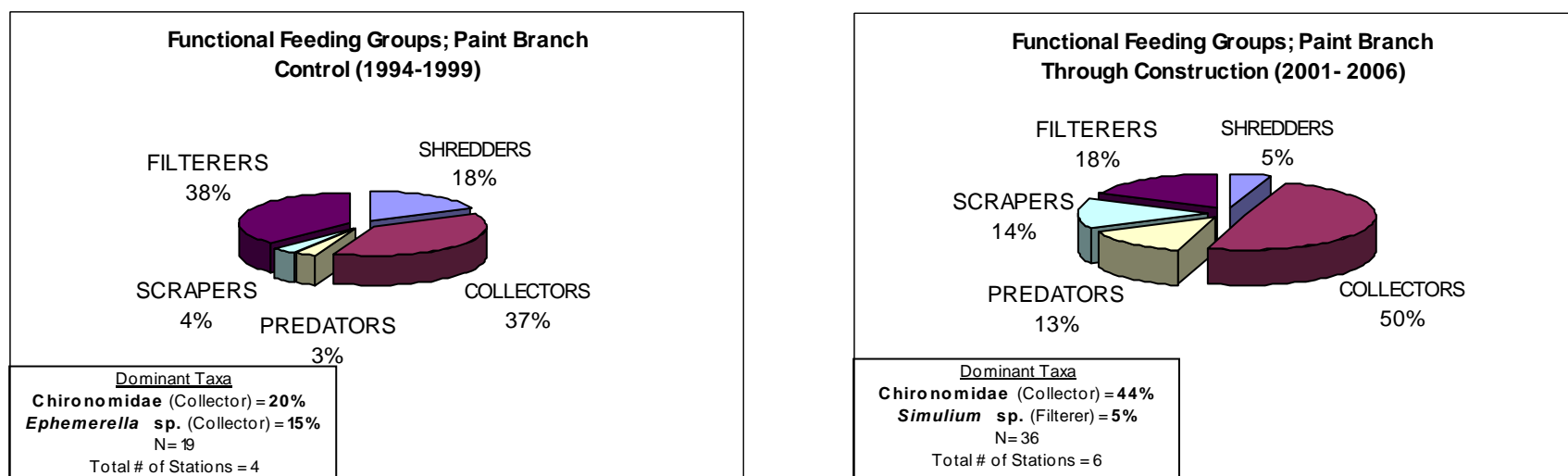


Figure TA-5. 12. Functional feeding groups and dominant taxa in the control areas of the Clarksburg SPA.



**Figure TA-5. 13. Functional feeding groups and dominant taxa in the test areas of the Paint Branch SPA.**



**Figure TA-5. 14. Functional feeding groups and dominant taxa in the control areas of the Paint Branch SPA.**

### **Literature Cited**

- Barbour M and Stribling J. 1991. Use of habitat assessment in evaluating the biological integrity of stream communities. In Gibson G. editor. Biological criteria: Research and regulation, proceedings of a symposium; 1990 Dec 12-13; Arlington, VA. Office of Water, U.S. Environmental Protection Agency, Washington, D.C. EPA-440-5-91-005.
- Jones R and Clark C. 1987. Impact of watershed urbanization on stream insect communities. American Water Resources Association: Water Resources Bulletin. 23(6):1047-1055.
- Kayzak, P. 2001. Maryland Biological Stream Survey sampling manual. Maryland Department of Natural Resources, Monitoring and Non-Tidal Assessment Division, Annapolis, MD.
- [MCDEP] Montgomery County Department of Environmental Protection. 1998. Countywide stream protection strategy.
- [MCDEP] Montgomery County Department of Environmental Protection. 1999. Special protection area conservation plan for Upper Paint Branch.
- [MCDEP] Montgomery County Department of Environmental Protection. 2000. Special protection area program annual report.
- [M-NCPPC] Maryland National Capital Park and Planning Commission. 1995. Upper Paint Branch watershed planning study – technical report.
- Pederson E, Perkins M. 1986. The use of benthic invertebrate data for evaluating impacts of urban runoff. Hydrobiologia 139:13-22.
- [U.S. E.P.A.] United States Environmental Protection Agency. 2008. Classification of Macroinvertebrates. <http://www.epa.gov/bioiweb1/html/invertclass.html>.

### **Note to Reader**

*For more information on Section 5 or technical appendix materials, please contact DEP at [AskDEP@montgomerycountymd.gov](mailto:AskDEP@montgomerycountymd.gov), 240-777-7700.*